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Productivity and nutritive value of *Brachiaria mulato* and *Centrosema pascuorum* mixtures at various ratios in Bauchi State, Nigeria

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Abstract

This study was carried out in 2023 at the Pasture plot of the Department of Animal Production Teaching and Research Farm, Abubakar Tafawa Balewa University, Gubi Campus, Bauchi State. Grass-legume mix ratios of *Brachiaria mulato* (BM) and *Centrosema pascuorum* (CP) at different mix rates (*B. mulato* only, 3 part B.M: 1 part C.P, 1 part B.M: 1 part C.P, 1 part B.M: 3 parts C.P and *C. pascuorum* only) were studied to determine their growth rate, yield and quality of the forages. Forages across treatments were fertilized at 150 kg/ha of Single Super Phosphate (SSP) in full application at 2 and 5 weeks of age. Plant mix ratios constituted the main plots and stage of harvest (4, 6, 8, 10 & 12 weeks) were the sub factor in a Completely Randomized Block Design layout. The highest (P<0.05) plant height was obtained at 1B.M: 3C.P plant mix ratio for both *B. mulato* (57 cm) and *C. pascuorum* (67.67 cm) plants separately. Plant height and tiller number were observed to have increased (P<0.05) as pasture weeks increased from week 4 to 6. Soil cover percentage was significant (P<0.05) and was highest (80.30%) in sole *C. pascuorum* followed by 53.33% in sole *B. mulato* and 1B.R: 1C.P mixtures. Plant mix rates significantly (P<0.05) increased leaf area index (LAI) and dry matter yield of *B. mulato* & *C. pascuorum* mixtures. The highest (P<0.05) total fresh (32.90 t/ha) and dry matter yield (10.31 t/ha) were in 1BM: 3C.P mix ratio at week 12 (31.55 & 9.35 t/ha, respectively). Similarly, the chemical composition showed 1BM:3C.P had the best (P<0.05) Crude protein (16.02%), NDF (51.94%) and ADF (40.98%) values compared to other treatments except sole *C. pascuorum* while week 10 had the best CP (17.28%), NDF (49.01%) and ADF (44.53%). Hence, *B. mulato* and *C. pascuorum* are recommended for planting at a mixed rate of 1B.M: 3C.P (1: 3) and harvested at 10 weeks old for best productivity for improved animal production.

Keywords: *Brachiaria mulato*, *Centrosema pascuorum*, Mix ratios, Week, Yield

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Introduction

Brachiaria Mulato II is a three-way hybrid and product of three *Brachiaria* varieties. It is a characteristic perennial grass with an average height at maturity between 80-100 cm, a very leafy vegetation and vigorous growth pattern. It has a crude protein content of 10-14% on poor soil and 12-18 % crude protein on fertile soils in tropical regions. The easiest way to enhance the nutrient composition of *Brachiaria* grass and maintain the nutritional value of the grass is by cultivating it in association with leguminous forages (Argel et al., 2006). One logical way of boosting animal production in Nigeria is by cultivating vast area of land with qualitative legume-based pastures. *Brachiaria mulatto* II requires a fertilizer applications rate of between 250-300 kg/ha of NPK fertilizer per annum in split applications. It will grow on low fertility soils but with lower yield, hence frequent fertilizer applications at higher rates are necessary on poor soils (Argel et al., 2006).

Legumes are palatable and nutritious tropical forages that are essential component of livestock nutrition. *Centrosema pascuorum* is an annual forage legume, grown mainly in tropical areas around the world. It is a valuable source of crude protein, crude fibre and mineral for livestock. It can also be used to improve soil fertility. *C. pascuorum* is a relatively easy crop to grow. It caned be planted in a variety of soil since it is tolerant to drought, heat and relatively resistant to pests and diseases. The nutritional value of *C. pascuorum* is high, the leaves contain between 18-20% crude protein and the seeds contain between 25-30% crude protein. *C. pascuorum* can be grazed by livestock, cut for hay or used to make silage (Castillo et al., 2003). Mixtures of grass and legume, grown in association helps to decrease input needed for forage production systems by reducing the use of industrial nitrogen (N) especially in grass stand (Whitehead, 1995). Intercropping grasses and legumes in pasture swards increased yield and pasture quality which in turn increased voluntary intake and forage digestibility (Aderinola, 2007). Grass-legume mixtures have an advantage over sole legumes because it will prevent incidences of bloat in animals as well as depth of soil erosion by legume cover (Minson, 1990). The role and contribution of legume plant component to the total forage yield of a mixed grass-legume stand depends on the relative seed proportion of plant component species. It has been reported that there exists a progressive increase in the contribution of the legume

component in a mixture with grass as the seed proportion of the legume increases (Onifade et al. (1994).

Therefore, determination of the optimum seed proportion is a key to establishing a balanced grass and legume mixed pasture. Furthermore, *Centrosema pascuorum* is a legume grown for forage and valuable to both livestock (as feed) and the soil because it improves the soil fertility by fixing nitrogen to the soil. There is no information available on the productivity of *B. mulatto* grown in mixture with any *Centrosema species*. Therefore, this study was conducted to investigate the influence of plant mix ratios on growth components, yield, and nutritive value of *B. mulatto* and *C. pascuorum*.

Materials and Methods

Location of the study

The study was carried out at the Pasture Plot of the Department of Animal Production Teaching and Research Farm, Abubakar Tafawa Balewa University (ATBU), main campus, Bauchi State. Bauchi State occupies a total land area of 49,119 km² representing about 5.3% of Nigeria's total land mass and at an elevation of 616 m. It is located in the Northern Guinea Savanna zone of Nigeria, it is bordered by Yobe and Borno States to the North, Kano and Kaduna States to the West, Gombe State to the East and Plateau State to the South. Bauchi state is one of the states in the Northern part of Nigeria that span two distinctive vegetation zones, namely, the Sudan savannah and the Sahel savannah. It has an average annual rainfall of 1150mm in 2023. Rainy season starts from April and ends in October, with an established rainy period of June to September (BSADP, 2023). The soil characteristics of the study location are shown below (Table 1). The soil sample was collected at a depth of 20 cm and taken to the Department of Soil Science laboratory, ATBU, Bauchi for analysis of its properties.

Table 1 Study location soil properties sampled at soil depth of 20 cm

Soil properties	Analyzed values
Physical properties	
Particle size (%)	
Sand	70.90
Silt	17.60
Clay	11.50
Textural class	Loamy sand
Chemical properties	
Total N (%)	0.80
P (ppm)	2.30
Zn (ppm)	1.50
Organic carbon (%)	0.90
pH (H_20)	5.98
Exchangeable cations (meg/100g of soil)	
K^+	5.30
Ca^{++}	3.42
Na^+	2.05
Mg^{++}	0.18

Field study, 2023

Experimental layout and pasture establishment

A land area of one hectare (1ha) measuring 100m x 100m in size was used to conduct the pasture establishment. *B. mulato* and *C. pascuorum* were sown at different plant mix ratios and as sole pastures for each species (control). The experiment consists of five (5) treatments planted in rows and at 1m row spacing (inter row) in a Completely Randomized Block Design. They include main treatments; Treatment 1: *B. mulato* only, Treatment 2: 3-part *B.* mulato: 1 part *C. pascuorum* (3: 1), Treatment 3: 1 part *B. mulato*:1 part *C. pascuorum* (1: 1), Treatment 4: 1 part *B.* mulato: 3-part *C. pascuorum* (1: 3) and Treatment 5: *C. pascuorum* only while stage of harvest (4, 6, 8, 10 and 12 weeks) are the periods of sampling of the experiment. The experimental pastures were sown in rows at 50 cm intra row spacing at a depth of 2 cm. Phosphate fertilizers (SSP) at a rate of 150 kg/ha was applied to the pastures as full dose, two weeks after establishment and at weeks five of pasture maturity.

Data collection

The number of tillers in each plant was counted and recorded within a 1m quadrat. Numbers of plants in a stand, height of plant, number of tillers in a plant and leaf area index (LAI) were measured at weeks 4, 6 and 8 after pasture emergence when plants have not attained full maturity. LAI was calculated using the procedure described by Adesoji et al. (2013). Forage yield was measured at full maturity at week 10 and 12 separately. Total fresh material cut per $1m^2$ quadrat ere immediately weighed (total fresh forage weight) after harvest to determine fresh forage yield per quadrat in each plant mixture. The grass-legume whole sample cut was separated

into grass and legume immediately after harvest to determine the proportion of grasses and legumes in the mixtures. The separated grass and legume cut were weighed individually and 250 g sub-sample taken the laboratory for oven drying to determine dry matter yield using the procedure of Tarawali et al. (1995).

Chemical analysis to determine the quality of forage samples

B. mulatto and C. pascuorum were cut at week 10 and 12 in this study for chemical analysis. The forage sub samples from *B. mulatto* and *C. pascuorum* were taken to the laboratory for oven drying and chemical analysis. Nitrogen content (N) of the forages was determined by the method of Kjeldahl while the protein content was calculated by multiplying the nitrogen content by a factor of 6.25 (N × 6.25). The Ash content was determined by procedure of AOAC (2005), while Van Soest method of forage analysis was used to determine Neutral Detergent Fibre (NDF) and Acid Detergent Fiber (ADF) (Van Soest et al., 1994).

Analysis of data

Data collected were subjected to Analysis of Variance using General Linear Model of (SAS, 2005) to statistically analyze the data from the field studies while Duncan's Multiple Range Test was used to determine significant difference (P<0.05) between means in a Completely Randomized Block Design (SAS, 2005).

Results and Discussion

Effect of plant mix ratios and stage of harvest on growth components of *B. mulatto* and *C. pascuorum*

Results shown in Table 2 indicated that number of plant per stand for *B. mulato* ranged from 9.10 in 1B.M: 3C.P to 10.63 in sole *B. mulato* and results were significant (P<0.05). There was a significant difference (P<0.05) in plant number per stand for *C. pascuorum* ranging from 4.90 plants in 3B.M: 1C.P to 9.23 plants in 1B.M: 1C.P. The height of plants for *B. mulato* and *C. pascuorum* pure stands and in mixtures increased (P<0.05) across treatment as *C. pascuorum* rate increased in the mixture and also as age of plant increases. Highest (P<0.05) plant height was obtained at 1B.M: 3C.P plant mix ratio for both *B. mulato* (57.0 cm) and *C. pascuorum* (67.67 cm) plants seperately**.** Kusvuran et al. (2014) obtained highest plant height at 80%HV: 20%AR in research with Hungarian vetch and Rye grass at different mixtures which indicated that sowing ratio influences plant height. The competition between *B. mulato* and *C. pascuorum* and or nitrogen fixation by *C. pascuorum* in the mixtures might have contributed to higher plant height in mixtures than the control (sole pasture stand) in the experiment. In addition, plant height increased (P<0.05) as pasture week increased from week 4 to week 8.

The highest tiller number per culm obtained in *B. mulato* pure stand could be related to the stand of *B. mulato* having zero competition from *C. pascuorum* and also, *B. mulato* having a strong vigor for growth with its erect growth pattern. The study observed that as *C. pascuorum* increased in mixture, the number of tillers in corresponding *B. mulato* decreased. Tillering in plant is a measure of growth potential for forage production by pasture plants. In this experiment, tiller number was observed to have increased (P<0.05) as pasture weeks increased from week 4 to 6. Soil cover percentage was highest (80.30%) in sole *C. pascuorum* which was followed by 53.33% in sole *B. mulato* and 1B.R: 1C.P mixtures. Mean values were significant (P<0.05) and increased as *C. pascuorum* increased in the mixture. *C. pascuorum* is a low growing legume with prostrate growth pattern and hence resulted in more ground cover than *B. mulatto*. Soil cover percentage increased as plant age increases due to increased internode elongation in stem and higher leaf area index.

Table 2 Indices of growth for *B. mulato-C. pascuorum* under different plant mix levels (%) and sampling period (weeks)

Treatments	Plants No./stand		Plants height (cm)		Tiller numbers		Cover mixture (%)
	B. mulato	*C. pascuorum*	*B. mulato*	*C. pascuorum*	*B. mulato*	*C. pascuorum*	
Plant mix ratios (%)							
Sole *B. mulato*	10.63^{a}	-	35.00^{c}	-	6.00^{a}	-	58.33^{b}
3B.M: 1C.P	9.56^{a}	4.90^{c}	42.33^{b}	43.92^{d}	6.22^{ab}	5.81^{c}	65.00^{c}
1B.M: 1C.P	9.89^{b}	9.23^{a}	44.09^{b}	56.58^{b}	7.33^{bc}	1050^{a}	68.33^{b}
1B.M: 3C.P	9.10^{c}	6.82^{b}	57.00^{a}	67.67^{a}	6.22^{ab}	11.04^{a}	75.00^{c}
Sole *C. pascuorum*	-	7.64^{b}	-	54.17^{c}	-	9.88^{b}	80.30^{a}
SEM	0.044	0.025	0.085	0.062	0.037	0.046	0.076
Sampling period (wks)							
4	8.33	9.70	41.36^{c}	43.50^{c}	5.80^{b}	7.67^{b}	40.00^{c}
6	11.65	8.23	45.50^{b}	53.15^{b}	5.27^{b}	8.40^{a}	65.00^{b}
8	10.98	10.40	50.21^{a}	66.56^{a}	7.73^{a}	9.03^{a}	90.00^{a}
SEM	2.201	2.097	4.093	5.172	1.281	0.953	1.056

a, b, c = Means in the same column with different superscripts are significantly different (P<0.05); **B.M** = *Brachiaria mulato*; **C.P** = *Centrosema pascuorum*; **SEM** = Standard error mean

Effect of plant mix ratios and stage of harvest on leaf area index, fresh yield and dry matter yield of *B. mulato* and *C. pascuorum*

Leaf area index (LAI), fresh and dry forage yields of *B. mulato and C. pascuorum*, separately as sole stands and in mixtures are shown in Table 3. Results obtained for *B. mulato* showed that LAI decreased from 3.75 in sole *B. mulato* to 2.64 in 1B.R: 3C.P mixture and showed significant difference (P<0.05) except for sole *B. mulato* (3.75) and 3B.R: 1C.P (3.69) which were at par. *C. pascuorum*, had no significant difference (P>0.05) in LAI across treatments. The LAI in *B. mulatto* steadily declined as *C. pascuorum* amount in the mixture increased, but increased as plant age increased. A significant reduction of leaf area index in the plant mix treatments as *C. pascuorum* increased was probably because of the competition between plant species above ground for light (solar radiation) and below ground for water and soil nutrients (Corre-Hellou et al., 2007; Valadabali & Farahani, 2010). LAI increased (P<0.05) as plant age (weeks), which proved that increase in leaf area led to an increased light interception and consequently photosynthesis which resulted in increased production (Reddy, 2000).

Effect of plant mix ratios and stage of harvest on dry matter yield of *B. mulatto* and *C. pascuorum*

The total fresh forage and total dry matter yield in *B. mulato* and *C. pascuorum* in sole stand and mixtures as shown in Table 3 ranged from 24.90 and 5.28 t/ha in sole *B. mulato* to 32.90 and 10.31 t/ha in 1B.M: 3C.P plant mix ratios, respectively and values were significantly different (P<0.05) from each other. The highest total fresh and dry matter yield (32.90 & 6.87 t/ha) was obtained in 1BM: 3CP which suggests better contribution of *C. pascuorum* in the mixture through nitrogen fixation compared to other treatments. Results for fresh forage yield obtained in this study (24.90 t/ha in sole *B. mulatto* and 32.90 t/ha in 1B.M: 3C.P) is very similar to the result (22.7 t/ha to 33.4 t/ha) obtained by Kusvuran et al. (2014) in a mixture involving Rye grass and Hungarian vetch at different mixture ratios and row spacing. However, it was higher than the range of 16.60 to 21.93 t/ha obtained by Sani et al. (2019) in a previous study with *B. ruziziensis.*

The results for dry matter yield obtained for sole *C. pascuorum* in this study (5.28 t/ha) was similar to the results obtained by Hassan et al. (2015), but higher than 3.3 t/ha obtained by Budisantoso et al. (2006). The highest total dry matter yield for the mixtures obtained in this study (10.31 t/ha) in 1BM: 3C.P mixture was higher than 6.87 t/ha obtained by Sani et al. (2020); (2023) in previous and similar researches when *B. ruziziensis* was grown in mixture with *C. pascuorum* and also, 7.0 t/ha obtained by Muhammad (2015) when Rhode grass and *C. pubescens* were grown in mix ratio of 1: 3 with phosphate fertilization. In this study, the highest fresh forage yield (32.90 t/ha) and dry matter yield (10.31 t/ha) yields were obtained in 1B.M: 3C.P plant mix level and the yields increased based on increasing *C. pascuorum* in the mixture. Higher legume proportion in mixed forages (grass-legume) increases the green herbage yield and hay per unit area and legume ratio in mixtures should not be below 60% for higher productivity and yield (Ozel et al. 2010; Sani et al. 2020 & Sani et al. 2023). Higher fresh yield (31.55 t/ha) and dry yield (9.53 t/ha) were both obtained at week 12 of plant harvest and were higher than the yield at week 10 (P<0.05). Values obtained were similar to results obtained by Kavut (2019) in a similar study on Persian clover and Rye grass at different mix ratios and 5.17 DM t/ha & 6.23 DM t/ha by Sani et al. (2020) at week 10 and 12, respectively both in a study on *B. ruziziensis*.

Effect of plant mix ratios and stage of growth on nutritive value of B. mulatto and C. pascuorum mixtures

As shown in Table 4, Crude Protein (CP) percentage increased (P<0.05) as the level of *C. pascuorum* increased (P<0.05) across treatments, from 13.30% in 100% sole *B. mulato* to 25.28% in *C. pascuorum* hay. When the quantity of legume plant in the mixture increased, the crude protein of that mixture increased while as quantity of grass increased in the mixture, CP content significantly decreased (Karagic et al., 2011). The CP for *B. mulatto* and *C. pascuorum* mixtures observed in this study were found to be similar with the findings of El-Kramany et al. (2012), Kusvuran et al. (2014) and Sani et al. (2023) on researches with grass-legume mixtures. Also, the CP concentration decreased with advanced stage of growth, with lowest CP value of 15.74% at week 12, but higher value for CP (P<0.05) at week 10 (17.28%). It was observed that crude protein decreased as pasture week increased, which was due to increase in the proportion of stem in relation to leaf fraction, increased cell wall concentration and lignification (Laredo & Minson, 1973). Crude protein concentration obtained in this study for the plant mix ratios at both week 10 and 12 were higher than the values obtained for *B. ruziziensis* grown alone and in association with legumes in a study by Enoch et al. (2005); Sani et al. (2020).

Neutral Detergent Fibre (NDF) ranged from 44.64% for sole *C. pascuorum* to 54.50% in sole *B. mulato*, the NDF values for *B. mulato* grown in mixtures were statistically similar (P>0.05). It was observed that the Acid Detergent Fibre (ADF) and NDF of *B. mulato* grown in mixture decreased as *C. pascuorum* amount increased in mixtures. Sole *B. mulato* had highest (P<0.05) NDF value (54.50), while plant mix levels of 3B.M: 1C.P and 1B.M: 1C.P had similar value (P>0.05), with the least NDF obtained in sole *C. pascuorum* (44.64%). The NDF and ADF of *B. mulatto* followed same trend and decreased as *C. pascuorum* amount increased which indicated that higher Crude Protein of the mixture resulted in a reduction of both ADF and NDF. The concentrations of NDF and ADF which are affected by intercropping are another important quality characteristic for forage (Lithourgidis et al, 2007). Increased forage legume quantity is associated with increased cell contents and decreased structural components which would have positive effects on its nutritive value (Haj-

Ayed et al., 2000). Grasses have more cell wall contents, lignin and cellulose components than legumes; hence they rapidly decline in digestibility as they mature (Tan & Mentese, 2003).

Results also indicates that ADF and NDF increased (P>0.05) as pasture plant weeks increased from week 10 (49.01 & 44.53 %) to week 12 (52.23 & 41.98 %) respectively. The ADF in this study increased as the plant age increased which corroborates with the reports of Minson (1990); Shehu et al. (2001) who reported that fibre fraction of legumes generally increases with maturity. Pure cereal plants are not recommended for feeding livestock due to their low nutrient content and yield (Karagic et al., 2011; Kusvuran et al., 2014). Values for Ash in this study were significant (P<0.05), they did not follow a specific trend and were within the range of 3-12% reported by Linn & Martin (1999) for most forage. The difference in results for *B. mulato* obtained in this study with reports of other authors is due to climatic conditions, varieties and location of the study.

Conclusion and recommendations

Mixtures of *B. mulato and C. pascuorum* had better yield values and quality than *B. mulato* monocultures (positive control treatment). The plant mixtures had greater Crude Protein (CP) than sole *B. mulato*, due to the availability and effective utilization of symbiotically fixed nitrogen (N). The clear difference in Crude Protein (CP) between the *B. mulato* sole stand and that in the mixture is due the low fertilizer N rate in sole grass stand compared to *B. mulato-C. pascuorum* mixed sward due to N fixation by *C. pascuorum* leading to higher quality of mixtures. Plant mix ratio of 1-part *B. mulato*: 3-part *C. pasuorum* (1: 3) had highest fresh and dry matter yield as well as best pasture quality in mixtures. Similarly, forage yield was quite lower at week 10 compared to week 12, but quality was better at week 10. Therefore, *Brachiaria mulato* and *C. pascuorum* should be incorporated at 1: 3 mix ratio (1B.M: 3C.P) and harvested at 10 weeks old for optimum forage productivity and nutritive value for improved animal production.

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Table 3 Leaf area index and forage yield of *B. mulato* and *C. pascuorum* mixtures as affected by plant mix ratios and stage of harvest

Treatments	Leaf area index		Forage yield (t/ha)					
			Fresh forage yield			Dry matter yield		
	B. mulato	*C. pascuorum*	*B. mulato*	*C. pascuorum*	Total fresh yield	*B. mulato*	*C. pascuorum*	Total dry yield
Plant mix ratios (%)								
Sole *B. mulato*	3.75[a]	-	24.90[a]	-	24.90[e]	5.28[a]	-	5.28[e]
3B.M: 1C.P	3.69[a]	4.32	18.71[b]	9.03[d]	27.74[c]	5.93[a]	2.45[d]	8.37[c]
1B.M: 1C.P	3.08[b]	2.69	15.90[c]	14.78[c]	30.68[b]	5.13[a]	4.18[c]	9.30[b]
1B.M: 3C.P	2.64[c]	2.51	10.46[d]	22.46[b]	32.90[a]	3.27[b]	7.02[b]	10.31[a]
Sole *C. pascuorum*	-	3.87	-	26.25[a]	26.25[d]	-	8.10[a]	8.10[d]
SEM	0.005	0.462	0.05	0.036	0.05	0.015	0.015	0.021
Stage of harvest (weeks)								
4	2.96[a]	2.46[a]	-	-	-	-	-	-
6	2.78[b]	2.34[b]	-	-	-	-	-	-
8	2.22[c]	2.13[c]	-	-	-	-	-	-
10	-	-	12.77[b]	8.05[b]	24.83[b]	4..04[b]	3.72[b]	7.76[b]
12	-	-	15.23[a]	10.89[a]	31.55[a]	5.01[a]	4.98[a]	9.35[a]
SEM	0.50	0.521	1.805	2.416	1.460	0.77	1.455	0.768

[a, b, c] = Means in same column with different superscripts are significantly different (P<0.05); **B.M** = *Brachiaria mulato*; **C.P =** *Centrosema pascuorum*; SEM = Standard error mean

Table 4 Chemical composition of *B. mulato-C. pascuorum mixture* as influenced by plant mix ratios and Stage of harvest

Treatments	Dry matter	Crude protein	NDF	ADF	Ether extract	Ash	Hemi-cellulose
Plant mix ratios (%)							
Sole *B. mulato*	90.53	13.30[d]	54.50[a]	45.81[a]	0.80[b]	9.74[b]	9.69
3B.M: 1C.P	90.02	13.82[d]	53.40[b]	44.40[b]	0.64[c]	8.68[c]	9.00
1B.M: 1C.P	88.97	14.12[c]	52.89[b]	42.81[b]	1.40[c]	10.74[a]	10.08
1B.M: 3C.P	89.30	16.02[b]	51.94[b]	40.98[b]	1.45[bc]	11.50[a]	10.96
Sole *C. pascuorum*	87.52	25.28[a]	44.64[c]	38.28[c]	1.90[a]	7.56[d]	6.36
SEM	0.320	0.05	0.767	0.157	0.084	0.043	0.103
Stage of harvest (weeks)							
10	89.10	17.28[a]	49.01	44.53	0.90	9.86[a]	4.48
12	90.56	15.74[b]	52.23	41.98	1.47	7.78[b]	10.25
SEM	1.890	1.374	2.081	1.652	0.431	1.870	1.230

[a, b, c] = Means in same column with different superscripts are significantly different (P<0.05); **B.M** = *Brachiaria mulato*; **C.P** = *Centrosema pascuorum*; **NDF** = Neutral detergent fibre; **ADF** = Acid detergent fibre; **SEM** = Standard error mean